Memorandum

To: William Bumpers, Baker Botts L.L.P.
From: Andrew Skoglund
Subject: CALPUFF Visibility Impact Variations
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Project: 34280013.01
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CALPUFF is the USEPA's preferred model for assessing visibility impacts at Class I Areas resulting from long range (50 – 300 km) plume transport. CALPUFF is a multi-source model which accounts for plume advection and atmospheric chemical reactions to estimate the concentrations of primary chemical species (ammonium nitrate, ammonium sulfate, elemental carbon, organic carbon, fine particulate and soil) known to cause haze (i.e., visibility impairment). Plumes in CALPUFF are transported using sophisticated meteorological data and plume transformations from atmospheric chemical reactions occur due to interactions of plume pollutants, background atmospheric pollutants (ozone and ammonia) and meteorological variables – most importantly water vapor as represented by relative humidity.

Visibility impairment is calculated as a function of the light scattering properties of atmospheric particles and gases. An increase in light scattering particles decreases the visual range as measured in deciviews. The EPA estimates that a sensitive observer may be able to detect a variation of 0.5 deciviews, with 1.0 deciviews being a more accepted threshold for distinguishable difference in visual impairment. Modeled visibility impacts of 0.1 deciviews are therefore indistinguishable to the human eye.

Calpuff modeled visibility impacts are reported in the model output files to thousandths of deciviews. However, this level of sensitivity overstates the potential accuracy of the model when compared to real-world observations. Assessments of the CALPUFF modeling suite versus real-world monitoring data demonstrate the potential for significant differences between modeled and actual concentrations. There are many model inputs which play a role in impact variability, ranging from background chemistry data to emissions data entered into the model.

Visibility calculations are directly affected by the background chemistry input to the model. While ozone is input to the model based on hourly observations from available monitoring locations within the modeling domain, ammonia inputs are calculated monthly average values. The use of monthly ammonia background concentrations in the model, allows for consistency between modeling runs, but is a simplification of the actual conditions and impacts to visibility. Variation in ammonia background can have a measurable effect on the chemical transformations in the model, and in turn on modeled visibility impacts. The background values for visibility impairing pollutants (ammonium nitrate, ammonium sulfate, elemental carbon, organic carbon, fine particulate, and soil.) are based on projected values of pristine or natural conditions. These also are input as monthly average background levels. Variability in actual backgrounds, while demonstrating definite seasonal changes, is not limited to changing by calendar month.

Additionally, the fixed nature of the modeled emissions utilized in BART analyses does not reflect actual operations of a facility. Few facilities will operate at their maximum 24-hour rate 365 days per year. The emission rates and parameters for the potential modeled scenarios use assumed emissions and fixed stack parameters (e.g. exhaust temperature, airflow) for scenarios not already in operation at a facility. Final design may yield variations in these parameters, an additional source of impact variability. There is the possibility for considerable variation in actual emissions versus the modeled maximum rates used for BART analysis. It could be expected that small changes to the source parameter assumptions would result in small changes to the model results. Therefore, if the assumed stack flow rate or temperature for the EPA BART controls were misrepresented by 10 - 20% from potential as-built values, it could be possible that the deciview difference would be on the order of 0.1 deciviews – i.e., within the sensitivity of the model.

Inasmuch as the BART modeling analysis methodology is proscriptive (e.g., model each facility individually, use background monthly ammonia values, etc…), the CALPUFF results from one model run to the next can be useful in a relative sense and not in an absolute sense (i.e., the CALPUFF model results are not expected to reflect observed values). However, the difference in results from any two modeling runs needs to be understood in context of the parameter estimated. For the BART analysis, the parameter of interest is deciviews and the human perceptibility threshold is 0.5 deciviews. On this basis, differences in model run results of less than 0.5 deciviews are not significant.

For the CCS modeling analysis, the model run differences are 1) baseline – current controls compared to 2) baseline – EPA BART controls. In both cases, the relative model results (baseline – controls) show a fairly large difference (up to 2 deciviews), giving some confidence in the modeling results that controls would result in perceptible improvements to visibility. However, the EPA's contention that the 0.1 deciview difference between 1) and 2) is actionable based on modeling, ignores the fact that 0.1 is the difference between two large numbers.

Given the many sources of variability of input to CALPUFF's visibility analysis versus actual impacts, a difference of 0.1 deciviews between options may reflect no real difference at all.